Framework Design Learning of Introduction to Computational Algorithms By Using the Theory Learning by Doing
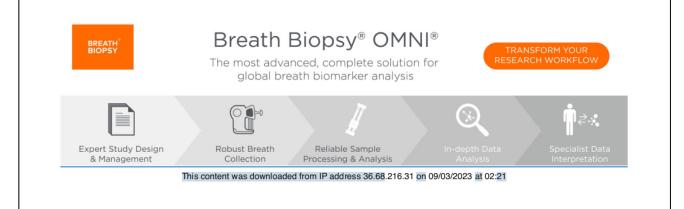
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Framework Design Learning of Introduction to Computational Algorithms By Using the Theory Learning by Doing

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Abstract: The purpose of this paper is to get the instructional design of introductory course for computing Algorithms for students who have the low marks of Math. They have kinesthetic and tactile learning styles in their learning. The discussion in this study is important because in some private universities in Indonesia found, that the new students of Informatics Engineering Program and Information Systems, they have below average of Mathematics ability, which is under 53 out of 100 points. The design of courses are prepared by using the theory of learning by doing. The question raised is how to apply the theory of learning by doing on the design of course outline. The result shows that the design of course outline is compiled using system approach with Context evaluation model, Input, Process, Product (CIPP) by using external stimulus in the form of Mathematical reasoning software for computational Algorithm, and avoiding imitation Mathematical reasoning from the beginning class, because it does not match the characteristics of knowledge on this course that are classified as conceptual and metacognitive knowledge.

1 Introduction

More than 70% of students STMIK Surabaya, Indonesia, have difficulty in learning Logic and Algorithm [1], as well as students in some other universities in Indonesia, such as Polytechnic of Bandung, University of North Sumatra, and Joint Program D4 BA. Therefore, from 2013 [2] to 2016 [1] efforts are made to improve their abilities by changing the learning model. The first, improving learning media in the form of software applications that serve to visualize the concept of branching and looping [2]. The results showed, there is slightly increase in their results, but the cognitive dimension was still C1 based on the bloom taxonomy [4]. The second, the improvement on the teaching model by using the theoretical framework of APOS [5]. The results showed, there was an increase in the cognitive dimension from C1 to C2. However, that improvement can be achieved, because there is outside stimulus such as: software applications and Logic learning Algorithms. This in line with Asiala [6], DeVries [7], Dubinsky [8], and Tall & Vinner [9] in categorized by an understanding of the level of action.

After observation and in-depth interviews found, that some student face difficulties: (1) understanding the process of automation in the form of Mathematical equations, (2) choosing the logical connectivity to determine the process of looping or branching, (3) choosing the flowchart symbol, and distinguish between the symbol of the looping and branching [10]. Then the observation was continued by giving test of Math and learning style. Test results showed, that 93% of students had kinesthetic and or tactile learning styles. Mathematics test results showed 80% of students can't

answers the question of linear equations with one variable, more than 90% of students can't answers the question of arithmetic for fractions. As summary, the calculation of the mean scores of both tests shows that more than 70% is below 53 out of 100 points. The data supported by Dunn and Dunn [11] which says that students with kinesthetic and or tactile learning styles have low Math skills.

The ability of Algebra and Arithmetic are as fundamental ability to learn programming Algorithms [12]. In learning Algorithms, and Algebra are used to knowthe process from input to output. While Arithmetic to understand the concept of variables and testing the truth of the Algorithm. As the results, to improve the learning of Logic and Algorithms, it requires additional learning about Algebra, Arithmetic of fractions, as well as basic Mathematical Logic. All subjects will be summarized in introductory learning of Computational Algorithms.

Therefore, the question in this discussion is "How to apply the theory of learning by doing on the design of instructional courses in introduction of Computational Algorithms". This learning by doing approach is expected to improve the competence of kinesthetic and or tactile students in this course.

2. Discussion

Learning design or lesson plan (known as RPP) is a guide for teachers or lecturers in implementing learning. According to Widoyoko that the RPP should contain at least four main features, namely: mature, sustainable, enforced in non-individual organizations, and for implementation the RPP should involve many people [13]. In this discussion, the meaning of mature is that RPP are arranged carefully based on facts with including competencies for graduate in the curriculum. Thus, the achievement of learning (known as CP) all components for output graduates should appear for each course outline (known as MK), it can be measured by all the elements involved in the learning system. The sustainable means that learning is of continuously process with synergy each other.

RPP in this paper contains 8 aspects, namely: learning objectives, teaching materials, learning methods, learning resources, assessment or examination, indicators of achievement, time estimation, and instructional media [14]. In addition, beside RPP also need form of evaluation.

Model evaluation of RPP contains of: Context, Input, Process, and Product, (known as CIPP). The rationale for selecting CIPP as the model, it's because focuses on improvements rather than proof. This characteristic CIPP is suitable for the objectives of the study, which is to improve the design of Logic and Algorithm learning that has been compiled since 2014 [5] and continues to be improved until now [12].

CIPP was introduced by Stufflebeam in 1965 [13]. He classifies into 4 (four) dimensions, namely: Context, Input, Process, and Product.

2.1. Context Evaluation

Context evaluation aims to gain a profile of the environment, needs, characteristics of the population, and objectives of program. The method used for evaluation are observation, document review, test, and interview. The learning program evaluated is a programming Algorithm.

Algorithm programming or Logic and Algorithm are a course in Informatics Engineering, or Information Systems. The learning objective of the course is to provide students with basic skills in terms of designing Algorithms presented in the form of flowchart and pseudo code, to solve computational problems, and to evaluate the results of the design. This course material is emphasized in automation process automation, which is presented in the form of flowchart and pseudo code [15].

With these characteristics, the knowledge learned in the Programming Algorithm as metacognitive knowledge [4]. According to Hartati [1] knowledge on Computational Algorithms includes factual, conceptual, procedural, and metacognitive. For example of factual knowledge by giving the name of the flowchart symbol and instruction, the symbol of Arithmetic operation, the relation of Logic. Example of conceptual knowledge by including data, variables, branching, looping. Example of procedural knowledge by including data sorting procedures, data search procedures. Example of metacognitive by exploring Algorithm for knowing true or false.

According to Skemp [16], to study conceptual and metacognitive knowledge requires the ability to relate one concept with another concept to produce a new knowledge, more complex concept, it's called a scheme. The power of the scheme is on the ability to combine and relate several different experiences, and to classify them. Therefore, the Computational Algorithm of instructional design should seek to achieve schematic formation in the beginning of the class.

The observations in this issue as follows: First, the design of learning can't be implemented because the requirements are not match for the students. The requirements are students should have basic Algebraic and Arithmetic. Therefore, the RPP needs to be revised. Second, the population is more than 80% of students have low Mathematical ability. Third, more than 90% of students have a tendency of kinesthetic and tactile learning styles. As results, there is wide gap between the achievement of learning and the condition of students. Thus the gap should be narrowed by giving program like matriculation with pre-requisite subject for the students whom didn't have basic in Algebraic and Arithmetic. This subject known as Introduction of Computational Algorithms course.

To achieve the objectives of RPP for Introductory Computational Algorithms are compiled based on the theory of learning by doing. This theory was introduced by Dewey in 1897 [17]. This theory is suitable for the conditions of students who have kinesthetic and tactile learning styles. According to Prashnig [18] individuals who have a kinesthetic style can concentrate in their learning when they are practice directly. While individuals who have tactile style can concentrate by touching or doing activities with their hands. Thus, learning is designed using hands-on and direct practice.

The above theory supports by Burner's theory [19]. He says that, almost all students use three skill systems for demonstrate their abilities. These three skills are: enactive, eclectic, and symbolic.

Enactive is one of skill, shows by action or direct practice that control through motor responses. For example, the students are required to run the application of Mathematical reasoning directly. The application is specially designed to train Mathematical reasoning skills, especially basic Algebra. Eclectic is one of the skill to show how to the present of knowledge by using images that reflect the concept, but not defining the concept directly.

Therefore, in the learning media for Mathematical reasoning software on Computational Algorithms is needed.

2.2. Input Evaluation

The input evaluation as input term, aimed at obtaining for profile of human resources, supporting tools and equipment, funds or budgets, procedures and rules to achieve the objectives.

Human resources include new students and lecturers. The vision of University Dr. Soetomo is Education for all, then all new students are given the same opportunity. In other words, the process of student recruitment is not based on cognitive ability alone, but more emphasis on attitude ability. Thus the factor of new students can't be changed, then the changing is on the learning system. Mainly to improve the ability of lecturers to overcome the challenge of a gap that is quite wide between the competence of graduates and new students' abilities.

For that reason, we come to improve in the learning process at University. The first step is to make the media for learning Mathematical reasoning software on Computational Algorithm. The media can be practiced directly repeatedly by the students until they are understand the indicators of each sub subjects. These improvements are expected to foster self-reliance and familiarize students to always strive to achieve a better than ever.

2.3. Process Evaluation

The aims of process evaluation is to determine whether the established plan can be implemented or needs improvement and innovation. Therefore, aspects of learning objectives, teaching materials, learning methods, learning resources, assessment of learning outcomes, indicators of achievement, time estimation, and learning media are considered in the RPP.

Based on observations found that, the learning process needs to be innovative in the form of creative Mathematical reasoning from the beginning of class. The cognitive dimension in this process

is designed on learning at C2 at the beginning. This determination is considered important, so the lecturers should think about the interrelationships between the ability of students and their schemes in making lesson plans or RPP.

Creative Mathematical reasoning is the Mathematical reasoning consist of three characteristics, namely: (1) selection of strategies using Mathematical basis, (2) sequence of steps to implement a strategy containing novelty elements, (3) explanations are arranged logically and sequentially [12]. As results, students must be trained to find more than one solution for each problem solving.

2.4. Product Evaluation

Product evaluation is emphasizes on achievement of the goals set during planning. To facilitate the product evaluation needs to conduct interviews on all components of the system. In this discussion, product evaluation focuses on CP charged to MK of Mathematical reasoning course on Computational Algorithms.

Product evaluation is design by using qualitative and quantitative approaches. A qualitative approach is used to obtain Mathematical reasoning profile on Computational Algorithms for kinesthetic and tactile students. While the quantitative approach used to test the rate of the use of instructional media

3. Conclusion

Based on the discussion, it can be concluded that to apply the theory of learning by doing on the Introductory of Computational Algorithms are: (1) the design Introductory Computational Algorithm course is compiled by using system approach such as: context evaluation, input, process, product (CIPP), (2) learning using stimulus from the outside of Mathematical reasoning software for Computational Algorithms, (3) avoid the reasoning of imitation Mathematics from the beginning of class because it does not match the characteristics of knowledge on Computational Algorithms as conceptual and metacognitive.

References

[1]   Hartati, SJ 2016 A Study of Knowledge and Reasoning Mathematics In Algorithms Computing Proceedings of International conference and calls for paper ADRI – UNITOMO Surabaya, Indonesia

[2]   Rahmawati and Hartati, SJ, 2013, The Application of Computer Aided Learning to Learn Basic Concepts of Braching and Looping on Logic Algorithm, The International Journal of Multimedia & Its Applications (IJMA) Vol5, No6, pp 15-24, ISSN: 0975-5934

[3]   Hartati, SJ, 2016, A Study of Knowledge Categorization In Logic and Algorithms, 11th Annual Education and Development Conference Bangkok: Tomorrow People

[4]   Anderson, J & Karthwohl, 2001, A Taxonomy for Learning, Teaching, and Assessing,New York: Addision Wesley Longman, Inc

[5]   Hartati, SJ, 2014, Design of Learning Model of Logic and Algorithms Based on APOS Theory International Journal of Evaluation and Research in Education (IJERE) Vol3, No2, pp 109 – 118, ISSN: 2252-8822

[6]   Asiala, M, et all, 2004, A Framework for Research and Curriculum Development in Undergraduate Mathematics Education Indiana: Purdue University

[7]   DeVries, David, 2004, Solution - What Does It Mean? Helping Linear Algebra Students Develop The Concept While Improving Research Tools, Proceedings of the 28th Conference of the International Group for the Psychology of Mathematics Education; 2; 55–62

[8]   Dubinsky, E, 1988, A Theory And Practice Of Learning College Mathematics In A Schoenfeld (Ed), Mathematical Thinking and Problem Solving; vol; 221-243

[9]   Tall, D & Vinner, S, 1981, Concept Image and Concept Definition in Mathematics with Particular Reference to Limits and Continuity Educational Studies in Mathematics 1981; 12; 151-169

[10]   Sulistiowati dan Hartati, SJ, 2015, Penerapan TAM pada Pembuatan Aplikasi Multimedia untuk Belajar Logika dan Algoritma Berbasis Gaya Belajar Laporan penelitian hibah bersaing DIKTI, tahun ketiga (tidak diterbitkan)

[11]   Dunn, R dan Dunn, K 1993 Teaching Secondary Students Through Their Individual Learning Styles, Practical Approaches For Grades 7-12 Massachusetts: Simon & Schuster, Inc

[12]   Hartati, SJ 2017 Kerangka Teori tentang Peranan Penalaran Matematika pada Pembelajaran Algoritma Komputasi Prosiding SENAMAS 2017, Peranan Matematika, Statistik, Ilmu Komputer dan Pendidikan Matematika dalam Memahami Sains, Teknologi, dan Budaya Maritim Makasar: Fakultas MIPA UNHAS Vol 2, hal 58-68 ISBN: 978-602-72198-6-1

[13]   Widoyoko, PES 2009 Evaluasi Program Pembelajaran, Panduan Bagi Pendidik dan Calon Pendidik Yogyakarta: Pustaka Belajar

[14]   PP No 19 tahun 2005, Pasal 20

[15]   Farrell, J, 2011, Programming Logic and Design Introductory, sixth edition, Canada: Course Technology

[16]   Skemp, Richard R, 1982, The Psychology Of Learning Mathematics, Great Britain: Hazell Watson &Vney Ltd

[17]   Dewey, J 1916 *Democracy and Education* New York: Free Press

[18]   Prashnig, B 2007 The Power Of Learning Styles Memacu Anak Melejitkan Prestasi Dengan Mengenali Gaya Belajarnya Terjamahan oleh fauziyah Kaifa Bandung

[19]   Burner, JS 1966 Toward a Theory of Instruction New York: Norton

Framework Design Learning of Introduction to Computational Algorithms By Using the Theory Learning by Doing

Mathematical Reasoning That Affects the Ability to Programming Algorithm", International Education Studies, 2020
Publication

8   library.polmed.ac.id
    Internet Source
    1%

9   repository.dinamika.ac.id
    Internet Source
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11 karyailmiah.unipasby.ac.id
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Publication
<1%

19 asais.pnj.ac.id
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20 id.123dok.com
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Publication
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